

The "Owl," Another Gauge "O" "Live Steamer"

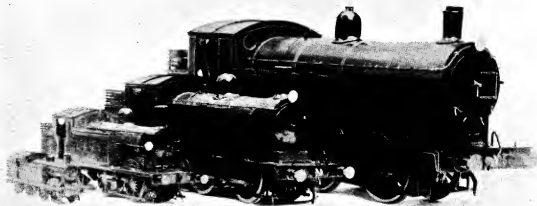
# THE MODEL ENGINEER

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Model locomotive enthusiasts often have a predilection for one type of locomotive. Mr. R. J. P. Mew, of Esher, appears to favour the S.R. Drummond 0-4-4 tank engines, judging by the photograph below, which shows his four miniature reproductions of this type, for "00," "O," "1" and 2½-inch gauges, respectively.



# THE MODEL ENGINEER

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February 29th, 1940

## Smoke Rings

### Fresh Ideas for Model Making

THE article by "Adage," entitled "A Plea for Fresh Ideas in Model Making," published in the "M.E." for January 18th last, has brought in several letters from readers. Some of these letters are being published, when space permits; but they lay more or less stress upon the main aspect of the matter, namely the difficulty of obtaining the necessary drawings and particulars of prototypes. There is no question of the fact that, in spite of the existing technical journals, and the frequency with which descriptions and illustrations of all manner of engineering prototypes appear in print, the actual information is seldom all that the model maker requires. Drawings, when published, are either too drastically reduced in size, too complicated for many amateur craftsmen to follow, or lacking in many essential details. But, in addition to all this, is the fact that most model engineers follow their own inclinations in their choice of a prototype; and few of them care to occupy their leisure hours on building models that cannot be applied to some practical enjoyment when finished. For this reason, boats and engines of all kinds are, by far, in the greatest favour; and mechanical rather than electrical engineering seems to fascinate a large majority of model engineers. "Adage" gave a list of some sixty prototypes, a few of which are already to be found in model form; but, a fact that lends some support to the remarks made above is that only about fifteen of the items in "Adage's" list come into the "electrical" category. Further, it is a matter for doubt whether any one of the sixty items, when reproduced as a working model, would give anything approaching the almost unlimited enjoyment that is to be obtained from a miniature locomotive or power boat. On the other hand, "Adage's" list certainly does suggest a vast field of exploration that might be considered by those of our readers who would care to attempt something new, though the final choice of subject is certain to be governed by personal associations.

\* \* \*

### A Swiss Miniature Railway

WHAT is thought to be the first passenger-carrying miniature railway in Switzerland is shortly to begin working. It is laid in the

grounds of Mr. Walter Brast's residence at Brugg, and the locomotive is a  $1\frac{1}{2}$ " scale L.M.S.R. "George the Fifth" 4-4-0, referred to and illustrated by Mr. W. J. Bassett-Lowke in our issue of August 24th last. At that time, this engine was in course of construction by Mr. Brast and his brother; it is now complete and ready for service, according to a letter recently received from Mr. Brast. The construction of a  $1\frac{1}{2}$ " scale L.M.S.R. "Royal Scot" type engine is to be started, as soon as possible, for the same railway. The choice, by our Swiss friends, of English locomotive types is interesting, and we hope that Mr. Brast will be able to send us some notes describing the reasons that led to such a choice. Also, we look forward to receiving further news of the railway, and some photographs of it. As is already well known, there are many expert model engineers in Switzerland, and the interest in miniature locomotives is very keen. It is, perhaps, natural that electricity, as the motive force for model railways, is most popular in that country; but, apparently, the fascination of the steam locomotive is about to receive some impetus. We hope that, in spite of difficulties arising out of the war, the brothers Brast will be able to continue their activities, and that their enterprise will meet with a big success.

\* \* \*

### Thursday, 29th February

THERE are many readers of the "M.E." who are mathematically-minded, and may be interested in the date at the head of this paragraph. It happens that there have been five Thursdays in the month that closes today; this can only occur in a Leap Year in which February opens on a Thursday. A cursory glance through the files of the "M.E." seems to show that, in no February since the "M.E." first appeared have there been five Thursdays, though we are open to correction on the point. As a matter of interest, some readers may care to investigate the question as to when five Thursdays will occur again in February, bearing in mind that, once in every century, the normal extra day in Leap Year is omitted.

*Perceval Marshall*

# \* Gauges and Gauging

A series of great value to engineers of all classes, particularly those who are engaged upon national service

By R. Barnard Way

## Indicating Gauges

IT is not too clear on what sense the use of the ordinary type of gauge, whether of the snap variety or any other that we have dealt with so far, depends for its use. To a certain extent sight comes into it, but perhaps touch is more important, we might combine the two and call it judgment. Different men employ different methods in coming to the same conclusions, but if gauging is to be carried to its proper end, then standardised methods must be employed. Set half-a-dozen men to measure the diameter of a truly round bar—a plug gauge even—with a vernier caliper, and see how many of them get the correct answer. Having made this test on several occasions, the writer has come to the conclusion that where it is possible, some kind of indicating gauge is necessary where final decision as to size is required.

This is no great thought on our part, let it be frankly admitted, for every man who has made and measured gauges knows that measuring contact cannot reliably be made with the aid of human touch alone. As we shall see when examining measuring machines, this difficulty has been got over in other ways. Even then there is no finality, though we are promised exactness to the one-millionth of an inch, exact enough in all conscience, of course, but still not final.

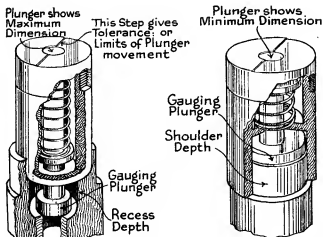
Indicating gauges cover a wide range of forms, from direct sight or touch types, to magnifying types that give a clearly read indication of error. Then there are gauges electrically operated that

ring bells when the specimen under test is true to size, or suitable for use in the assembly. In this way, we have a third sense brought in for use, though gauges of this sort are not commonly met with. We confess we have not used them, so our review, if it is to include all sorts, must depend upon the experience of others in that direction.

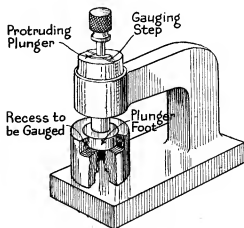
About the simplest sort of indicating gauge is the Flush Pin type, used for work where there is a recess or a shoulder to be checked. Here are two drawings to illustrate the type, which, though simple enough in principle, needs accurate workmanship in making. They consist essentially of spring-loaded plungers working freely in cylindrical boxes, one end of the box being finished very exactly. This surface is divided into two halves, these being stepped by the amount of the tolerance, whatever that may be. The protruding end of the plunger is exactly finished so that when its gauging end is in contact with a specimen of the dimensions, the outer end is midway between these two surfaces. So long as this end lies between the two surfaces, the specimen is acceptable. To judge to a nicety with such a gauge, touch, with a sensitive index finger is necessary, though sight, where good illumination is available, as it always should be, will settle most decisions. Experience shows that sight can be depended on for 0.0005", but touch does just better, and can be relied upon to the extent of 0.0003".

We show a third type of gauge of this sort, with a fixed base; here the work must be brought to the gauge, where the previous sort is portable. The obvious point about flush pin gauges is that they

\*Continued from page 173, "M.E.," February 15, 1940

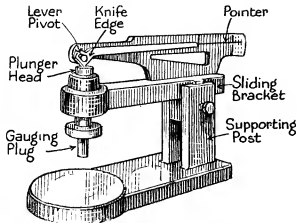


Flush-pin gauges: part sectional to show arrangement.



Bench-type of flush-pin gauge.

do not give a positive rejection of work not true to gauge, as a snap gauge would, but then they are designed to deal with difficult shapes that do not lend themselves to gauging of the go and not go sort. The measurement of the depth of a recess is a job requiring care and judgment, and it would be quite out of the question to deal with a large batch of parts by individually measuring each one with a depth gauge. Nor is it possible to arrange a go or not go gauge for such a job. The flush pin does it nicely, by



A simple multiplying lever comparator.

bringing the two reference surfaces out to a point where they can be seen easily, and in a practical manner, also bringing them close together so that any error is immediately seen.

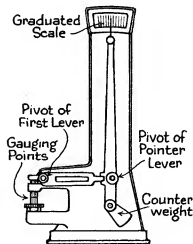
Carrying this idea a step further, we get the multiplying lever variation. Instead of dependence upon sight or touch for the decision, the deviation from true size is magnified by a lever or combination of levers, ending in a pointer moving across a fixed scale. The simplest type is illustrated first, this gives a magnification of 25 to 1, so is not of much real use where thousandths of an inch are concerned, as a variation of  $0.001''$  either way is covered by  $0.05''$  on the pointer scale.

The work to be judged is put on the anvil base, after lifting the gauging plug. The bracket is made adjustable, sliding in the supporting post, so that a variety of settings can be made; and by slotting the hole in the indicating pointer that takes the fulcrum-pin, variations in the magnification are also possible, though this is not usual. It is, in fact, a feature of yet another "home-made" gauging device of the author's that gave good service many years ago, settling a good many workshop arguments one way and another. As a principle, it would not meet with approval from the professional gauge-maker, chiefly because the degree of magnification could not readily be determined, though its range lay between 25 and 100 to 1.

It must be emphasised that the multiplying lever type of gauging device is, in a sense, not

really a gauge at all. More usually it is referred to as a "Comparator," a word that, perhaps, explains itself; its real purpose is to compare a batch of pieces with a master dimension. The last occasion on which we used one was to check up a hundred or so blades for feeler gauges; the measuring anvils having been accurately set at the  $0.005''$  to which all were supposed to conform, the blades were checked one by one. The instrument used for this job was one that we shall see in a moment.

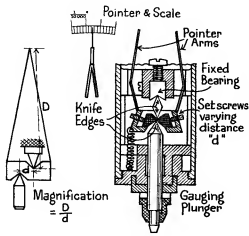
The next step is to combine the movement of two or more levers, so that the long end of the first bears on the short end of the second, the long end of this second one forming the indicating pointer. In this way, a magnification of 250 to 1 is quite a simple matter, and the pointer shows some movement across the scale, though even so it does not amount to a great deal. If the tolerance is, say,  $0.0005''$ , then the total movement across the scale would be only  $0.25''$ , but still a very useful indication, and quite adequate to give reliable readings on either side of a zero central mark on the scale. Obviously, the construction of such an instrument demands very careful work, for no backlash or slack in the working parts can be permitted; a sketch illustrates the essential details of one of those in general use. The second lever is counter-weighted to balance it nicely, this gives a smoother action than springs would do, but it means that the instrument must be kept upright in use; it is, in



A two-lever multiplying comparator.

fact, designed for bench use only. The gauging anvils are adjustable, to provide considerable latitude in the size of specimens for gauging.

To set these anvil points to some particular standard size, a reference gauge, such as one of the Johanssen blocks, is placed between them, and the adjustable one is then screwed up to make good contact. Care has to be taken to see that the indicating pointer remains at zero. The value



The Hirth Minimeter.

of the graduations on the scale can be checked by subsequently inserting gauges of a size larger and smaller by, say, 0.001", and observing the degree of movement. These graduations will, of course, be specified as to their value by the makers, and will not vary, whatever the size of the gauged specimen may be, within the limits of the machine. Periodic checking, however, is advisable.

The acme of refinement in the magnifying lever type of gauging machine is surely the Hirth Minimeter, also designed for bench use, and careful handling, though it is robust enough in its constructional details. The principle is ingenious, being based on the action of a lever supported between two knife edges, the upper one of which is diamond-shaped section, bearing against a fixed support. The lower knife edge is formed on the top of the measuring test-pin, made to slide in and out of the base of the casing. The bearing lines of these two knife edges are not directly over each other, being set slightly out of line, and the extent of this obliquity can be adjusted. Actually, the degree of magnification is in the ratio of the whole length of the pointer lever to the short distance between the knife edges, as shown in the diagram.

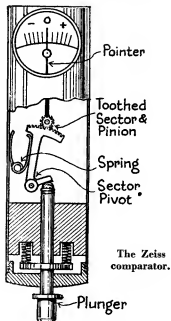
To alter the degree of obliquity, there are two setscrews clamping the bearing V-block in the lever, these are clearly indicated in the drawing, which, incidentally, is only diagrammatic. The whole device is enclosed in a steel tube, one inch by six. A variety of clamping stands are available for this pretty device, making its use more convenient for special purposes, notably the gauging of steel balls, a not-too-easy job at the best of times. It was the Hirth Minimeter we referred to, just now, as the machine on which we tested out a batch of feeler gauge blades. They are made in at least four powers, the scale graduations representing 0.001", 0.00025", 0.0001" and 0.00005" respectively.

The well-known Zeiss company, makers of optical gear, make also a useful little comparator gauge of this sort, though it is not to be reckoned

as a multiplying lever device. Here is a sectional layout to show its essential parts, simple enough. The scale graduations represent 0.001", or 0.01 millimetre, and there is a trigger to lift the measuring spindle when inserting or removing specimens. The whole thing is in a tube, one inch by four, and, like the Hirth Minimeter, it is designed to work in a clamp stand for greater convenience.

There are a number of other machines of this sort, but there is not room here to include more. The dial gauges are also indicating gauges, with a wide range of usefulness.

One word of warning to the beginner at gauging, and maybe the older hand too. We have often seen measurements being taken, in all seriousness, to estimated parts of a thousandth of an inch; the mechanic's fingers were covered with oily dirt, and the work being measured was little better! The cheerful announcement of a carefully read 4.038—and say another 0.00025 beyond—included almost certainly 0.018" of dirt. This is an extreme case, obviously, but it is very easy for an almost invisible speck of metal filing to obtrude



itself between the work being measured and the measuring spindle with quite possibly disastrous results. The table type of flush-pin gauge illustrated is particularly liable to this happening. Absolute cleanliness is essential, and we do not mean the rub over with a handful of oil waste, either. Gauge-makers use petrol as a rule, though this is not to be recommended in the shop. However, much can be done with clean mutton cloth, so do not forget—even the thinnest film of oil has some thickness, and you might be surprised to find how thick it can be. It is not easily squeezed off a flat surface by the micrometer spindle.

(To be continued)

# Model Engineers and National Service

\* Capstan and turret lathes

By Edgar T. Westbury

## Essentials of Accurate Production

THE dimensional accuracy of work depends, first of all, upon the correct adjustment of the tools and stops, steadies or auxiliary slides; but it is one thing to obtain initial accuracy of setting, and quite another thing to ensure that a large quantity of components can be produced to fine limits before it becomes necessary to re-set the tools. It is, however, absolutely essential that accuracy of production should be maintained for long runs if expensive rapid-production machines are to justify their existence.

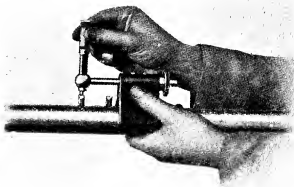
For this reason, the capabilities of tool steels, and their suitability for various materials or types of work, must be fully understood, and while high speeds and heavy cuts must be exploited to the limit, it is necessary to avoid running the lathe just that trifle too fast, or taking a cut which is just slightly too heavy. An overloaded tool wears very rapidly, even if it does not reach the stage of failure or chipping of the point, and thus, although it may be capable of carrying on work for long periods under such conditions, the quality of finish will deteriorate, and dimensional accuracy get steadily worse; while the power required to drive the lathe will increase, and abnormal heat will be generated in the process of cutting.

Apart from the question of the tool steel itself, it is most important to grind the tools correctly in respect of rake and clearance angles, and also finish. A tool ground to a very high finish will obviously resist wear much longer than one having a rough finish as produced by a coarse grinding wheel, and this fact is fully recognised in modern production shops. Special finishing wheels are commonly used, and in some cases lapping is resorted to in order to obtain the highest possible finish. Hand grinding is in many cases abandoned in favour of special grinding machines in which the tools are clamped in holders at the correct angles for producing the rake and clearance faces. This not only results in much more accurate and efficiently-cutting tools, but also shows an economy in tool steel compared with the older methods.

The amount of wear which may be expected to take place in a tool will clearly depend very largely on the amount of metal which it is called upon to remove, other things being equal, and thus it is usual, in cases where heavy cuts have to be taken, to follow up with one, two or even more lighter finishing cuts. By this means it is possible to

considerably reduce the wear of the tool used for the final cut, and thus preserve the accuracy of setting. Specially hard grades of tool steel, including tungsten carbide, have obvious advantages in this respect and are being increasingly employed for work which must be held to fine limits.

Correct lubrication also plays an important part in the durability of tools. Not only is it essential to have an adequate flow of lubricant, directed right on the tool point, but it must also be the right lubricant for the work in hand. The various soluble compounds and cutting oils all have their special properties and specific uses, and the old idea of using one selected compound for every machine in the factory is now entirely obsolete. Some notes on this subject will be given later.



Setting the cutters of a boring bar to cut to an exact diameter, by means of the Herbert boring cutter micrometer.

## Setting Tools to Fine Limits

The standard "box" tool-holders having no special provision for fine adjustment are not easy to set to cut an exact diameter, but some highly exact work is nevertheless often done with such tools. One method of setting which is very often practised is to set both the tool and the steady roughly to cut oversize, and then after measuring up the work thus produced, to make two or three more trial cuts, resetting by trial and error until the desired result is achieved. This method is, however, rather tedious, especially when both the tool and its steady can only be advanced by slackening off and tapping into position. It will in such cases, be generally found easier and quicker to first turn down the bar to the correct diameter by means of a tool held in the cross-slide

\* Continued from page 184, "M.E.," February 22, 1940.

tool-post, using it in precisely the same way as in ordinary engine lathe turning. After checking the size with a micrometer, the tool-holder is advanced over the work, and the steady first set on to it by finger pressure and clamped in position. The cutting tool is then carefully set in the same way, and also tightened up. With reasonable care, the tool-holder, when set in this way, should produce work within one or two thousandths of an inch of the correct size. It will be found that small

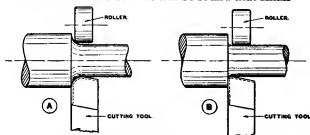


Fig. 32. When setting steadies, care must be taken that they do not ride on the fillet produced by the cutting tool, as at A, but bear evenly on the work, as at B.

variations of size can be produced by varying the finger pressure when setting the steady against the work. Should the tool be found to cut 0.0005" to 0.001" undersize, it is often easier and quicker to oil-stone the edge slightly while it is in position than to attempt complete resetting.

As previously pointed out, roller steadies will generally produce work of a higher finish than that possible with vee steadies, because of their burnishing effect, and on free-cutting mild steel and other fairly soft materials, quite deep cuts can be taken and finished at once over without fear of undue wear, assuming, of course, that really good tool steel is used. Harder or less homogenous materials, including alloy steels and common cast-iron, which may contain particles of foundry sand, are more exacting in this respect, and usually call for one or more preliminary roughing cuts before finishing with a very hard and finely-ground tool point.

When using a roller tool-holder having fine adjustment to the tool, sizing is very much facilitated. Such holders are often equipped with a quick-withdraw motion, which enables the tool to be relieved from the work before returning the capstan slide, thus avoiding tool marks on the finished surface. The pros and cons of leading or following steadies have already been discussed, but it may be noted that when the latter type are used, and the tool has a radius at the nose, the tool setter is sometimes so keen to keep the steady as close as possible behind the tool, that it may ride on the fillet, and thus fail to properly either support or burnish the work (Fig. 32). The steady should always bear squarely upon the parallel surface of the work; this applies to all types of roller or vee steadies.

A tool-holder having withdraw motion can be used to take a facing cut across the shoulder at the completion of its normal motion. In this case,

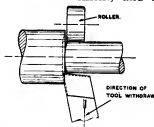
the tool should be raked forward, or, alternatively, ground back obliquely from the front edge, so as to slightly undercut the face, as shown in Fig 33. If the tool is gradually withdrawn while in contact with the face, a square shoulder is assured, without relying on the squareness of the tool face.

Concentric diameters, or "stepped" work, may be produced by using successive cuts with tool-holders having leading steadies, or by a gang of tools in a box holder. The latter is obviously quicker, but may be difficult to set to close accuracy, as the following tools may affect the leading tool when they start to cut. This propensity may be cured by careful adjustment of the individual steadies, but it is often more trouble than it is worth. The use of single and double tool-blocks, which may be mounted in a standard box tool-holder, is illustrated in Fig. 34, and while the standard equipment may not cover every requirement in respect of the lengths of the various diameters to be produced, it is not a difficult matter to make up tool-blocks to suit particular requirements.

The setting of other types of tools will follow, roughly, the same principles as outlined above. Facing tools can be adjusted by end stops, while forming, grooving and similar tools held in the four-way tool-post are adjusted by the cross-slide and saddle stops.

The adjustment of internal tools can be facilitated by mounting them in round bars of a definite size, assuming that these are in turn concentrically mounted in a fixed centred holder on the capstan head. This allows of setting the tools themselves by direct measurement, and a

useful micrometer gauge for this purpose is shown in the photograph. The method of using it is to hold the vee block firmly against the bar, and screw down the gauge point until it makes



contact with the work. After noting the reading, an-  
holder to face a shoulder squarely, other measurement is taken over the point of the cutter; the difference between the two readings equals the distance the cutter projects radially beyond the bar. The size of hole it will bore is equal to the diameter of the bar, plus twice the radial projection of the cutter. This, of course, only holds good for concentrically-mounted bars or tool heads; if they are offset, the diameter is increased by twice the throw, or distance off centre, at which they are mounted. Incidentally, it may be noted that bars which have to be steadied by means of a pilot bush in the mandrel cannot be mounted otherwise than concentrically, though special boring bars have been made with an eccentric adjustment of the portion carrying the tool (thus allowing of varying the bore size

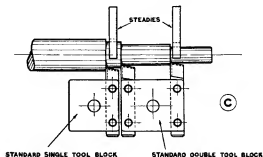
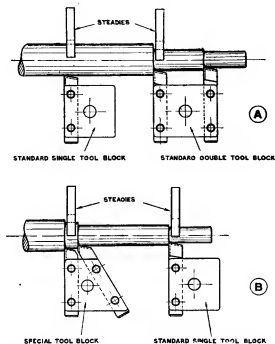


Fig. 34. Producing stepped diameters by multiple tools, held in standard or special tool blocks in a box tool holder.

machined, or providing a withdrawal motion), but retaining the pilot in its concentric location.

### Sequence of Operations

By far the great majority of capstan and turret lathe work is inherently simple, especially the bar work encountered in general engineering practice, which consists mainly of bolts, nuts, terminals, bushes and miscellaneous fittings, which are produced in moderate quantities, insufficient to justify the use of automatic lathes. In such work the procedure is quite straightforward and logical, the sequence of the operations performed by the various tools being usually fixed, that is to say, the only sequence possible by the very nature of the work.

Suppose, for instance, small bolts are to be produced from hexagon bar stock. The collet chuck is fitted with suitable section pads to hold the bar, a length of which is inserted from the back of the mandrel, and in cases where bar-feed mechanism is provided, its rear end is carried in a small chuck or steady connected to the propelling gear. When the collet chuck is opened, the bar is thus pushed forward until it abuts against the work-stop, which is thus the first thing to be set. Fine adjustment is not usually called for, as it is only necessary to ensure that the bar projects a sufficient distance to enable the full length of the required component to be turned and parted off, at the same time avoiding unnecessary overhang. Incidentally, when a new bar is inserted in the machine, it will usually be rough on the end, so it should be faced or parted off before allowing it to run out against the work-stop and re-closing the chuck.

Having adjusted the position of the work-stop with the capstan slide extended, the corresponding

end-stop of the latter is set and locked, and the slide run back to index the capstan to the next tool position. This, in the component under discussion, will be occupied by either a roller or vee steady tool holder for running down the shank to the required size; or, for specially accurate work, the first stage may only be a roughing cut. In either case, the cutter is adjusted for diameter as previously explained, and for length by setting the capstan slide end-stop. If close limits on length are to be observed, it will be advisable to make a trial cut and check up before finally

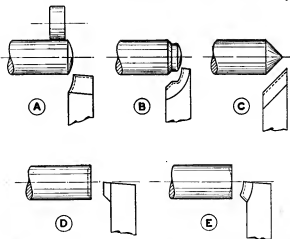


Fig. 35. Various types of "ending" tools used for finishing the end faces of bolts and similar components.

locking the stop, but due allowance must be made for any reduction of length which may be caused by the use of ending tools.

Before screwing the bolt, it is advisable to bevel the end to assist the start of the dies; this may be carried out by a capstan tool or one mounted on the cross-slide. Bolts usually have rounded ends, but in many cases the finish rounding or bevelling operation is left until after the thread has been cut, so that it removes the burr thrown up by the dies.

(Continued on page 215)



# The "Owl"

Blackout Bird No. 2

By "L.B.S.C."

IN fulfilment of my promise recently made, here is an outline sketch and first details of the second "0" gauge engine for building and running indoors during blackout evenings. As a glance will show, I based her on the well-known "4F" 0-6-0 goods engines of the L.M.S., but introduced certain variations to combine efficiency of operation with ease of construction, although the overall length, wheelbase and certain other dimensions correspond to "big sister." I honestly assure you it is some job to scheme out these pocket editions, one trouble being that Nature refuses to be scaled, and another is that if the job appears too complicated, everybody is going to be scared clean away from it at the start! Anyway, I have done my best, and hope the result will meet with approval. If anybody wants to turn it into a similar engine of one of the other groups, go right ahead with the same working parts, but adorn them with top works and trimmings according to taste; e.g., she would look fine in the "uniform" of a Southern "Q" class, or made up *à la* the old Great Eastern.

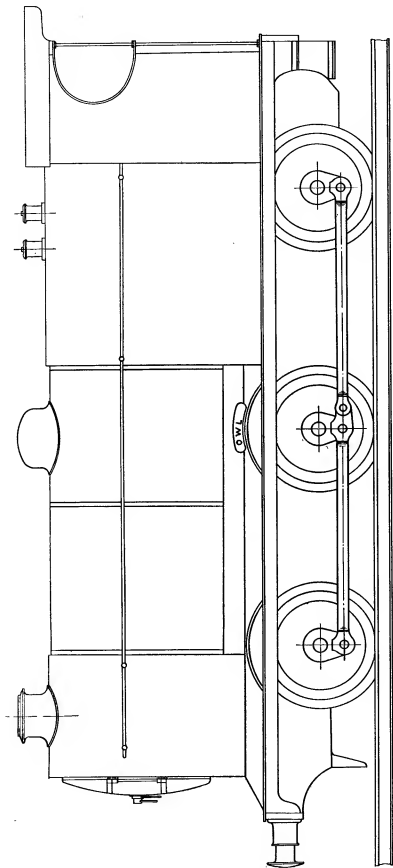
## Variations

The two principal variations "from scale" are the larger boiler and smaller wheels. The correct size of boiler barrel should be  $1\frac{1}{2}$ " diameter, but this is only capable of carrying the proverbial teaspoonful of water, and with only a tender hand-pump, a good non-stop run would be out of the question. Therefore, I increased the size of the barrel by  $\frac{1}{2}$ ", bringing it to the same diameter as the "Bat's"; also, by keeping the well-known Fowler straight-sided Belpaire firebox, with a special type of inside firebox allowing a grate the full width between frames, the boiler will hold quite a tidy drop of water, and also will not be liable to sudden variation of pressure due to "raw-recruit" firing. I will also give the water-tube variation, with the same outline, for firing with paraffin, "pool" or "eau-de-cologne"; but with some kinds of the last-named, it might be advisable to have your gas-mask handy!

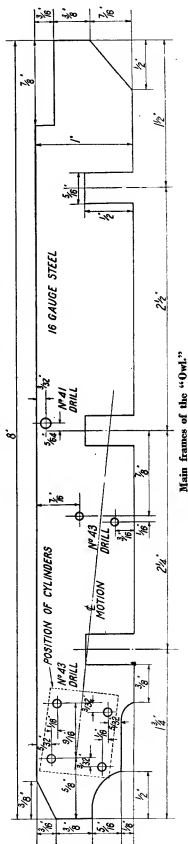
The correct size of wheel would be  $1\frac{3}{8}$ " diameter, but here again there was a very important factor that made me specify  $1\frac{1}{2}$ ", although the former size wheels are on the market, and we shall use them for the tank engine, "Miss Inky." Owing to the comparatively larger clearances, wider wheels, and so on, necessitated by the small gauge, we have only  $13/16$ " between the frames; and the biggest pair of cylinder bores that can be squeezed in by the average locomotive-builder would be  $11/32$ " each. This only leaves  $\frac{1}{4}$ " to split up into

three clearances, viz., between the bores and frames, and the bores themselves, which is cutting things pretty fine. In order to get plenty of power, therefore, I decided on the smaller wheels, which are the "scale" equivalent of those on the old L.N.W.R. 0-6-0 coal and mineral engines. With  $11/32$ " cylinders,  $1\frac{1}{8}$ " wheels, and about 70 lb. on the clock, the "Owl" should have no difficulty in hauling sixty wagons and a couple of brakes (if you have that amount of rolling stock!) with the slow movement, terrific blast, and display of fireworks as per the full-size article; a few degrees more realistic than the feeble efforts of the pot-boiled toys hailing from the land of the swastika, and a million times better than any clockwork or electric imitation locomotive totally devoid of "life"! The engine will also take a young hopeful for a joy-ride, if a suitable flat car is available, and he or she can only be persuaded to sit still on it without fidgeting about—the hardest task a kiddy could ever be persuaded to undertake!

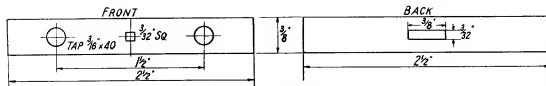
With only a matter of  $13/16$ " between the frames, I should imagine you are all wondering how the merry dickens we are going to get the works in, and at the same time make them robust enough to stand up to a spot of hard work. Well, it certainly is some job, especially as there is the valve-gear to provide for. The cylinder bores must be  $25/64$ " centres, to allow  $3/64$ " between bores, and barely that between bore and frame; and with all crank webs only  $1/16$ " thickness, giving  $\frac{1}{8}$ " width of big-end bearing, there would be only  $\frac{1}{4}$ " available between the inner webs, which is not sufficient for a pair of eccentrics, either loose type or for operating any radial gear. The only way out, so far as I can see it, is to make the crank webs circular and use them as eccentrics; a scheme I tried out, and described in the old "Live Steam" notes, on a  $2\frac{1}{2}$ " gauge engine many years ago. The only radial valve-gear that will operate with the eccentrics "in step" with the cranks (as they must necessarily be if the cranks *are* the eccentrics) is the Hackworth gear; so Hackworth it is. The inner webs can be made wide enough to fill up all the available space on the crank axle, and will be a full  $\frac{1}{4}$ " in thickness, so there will be plenty of wear-resisting bearing surface for the straps. There is just room between the upper sweep of the cranks, and the bottom of the boiler barrel, for a pair of small diameter but wide Hackworth slide blocks, with direct connection from the top of the eccentric-rods to the valve-spindles. It is hardly necessary to add that proper lap and lead will be provided, and the tiny



No. 2 of the "blackout series" the "O" gauge goods engine.



### Main frames of the "Owl."



Front and back beams.

engine will notch up, same as its full-sized sister, with resulting economy in the amount of steam consumed for work done.

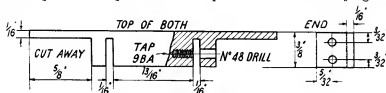
Before proceeding to constructional details, there is one point to clear up; several readers want to know if these "blackout birds" can be enlarged to  $1\frac{1}{2}$ " and  $2\frac{1}{2}$ " gauge. Certainly they can, and the general instructions for "0" gauge can be followed, with certain variations. For gauge "1," increase all *general* dimension in the proportion of 5 to 7, but make *detail* dimensions conform to the correct size for the gauge. For instance, gauge "1" frames are  $1/16$ " thickness and set  $1\frac{5}{16}$ " apart. The axleboxes may be made exactly as described for gauge "0," running in plain slots in the frames, or they may be wider, and run in slots thickened up by horseshoe-shaped pieces of frame steel, riveted on to form hornblocks. The wheels are increased to proportionate diameter; but the width of tread, and the thickness and depth of flange, remain the same as for gauge "0." The cylinders of both engines, "Bat" and "Owl," may be  $9/16$ " by  $1\frac{1}{2}$ ", but made according to the gauge "0" drawings as regards "personal appearance."

In  $2\frac{1}{2}$ " gauge, double all general dimensions, but alter detail measurements to suit the gauge, as mentioned above. Thus the frames will not be  $\frac{1}{4}$ " in thickness, but  $3/32$ ", set at a distance of  $1\frac{15}{16}$ " between; the usual type of  $2\frac{1}{2}$ " gauge angle buffer beams would be needed; hornblocks, of the cast or hot-pressed pattern, as specified for

### Main Frames

As with the "Bat," 16 gauge bright or blue steel is used for the frames, two pieces 8" long and 1" wide being needed. They are easy enough to cut out, being all straight lines except the two small radii at the leading end, but be careful about marking off and drilling the holes correctly. Although the staggered holes at the leading end are only for the cylinder fixing screws, they need to be drilled in the right places, otherwise there is a risk of piercing the cylinder bores, as the latter take up nearly all the available space between frames. Holes drilled as indicated, will enable the screws to miss the bores altogether. The two staggered holes between the first and second axlebox slots, are for the screws securing the motion plate, or spectacle plate, as the engine-men call it, which supports the ends of the guide bars. The position of the hole shown above the slot for the driving axlebox is very important, as these holes are for the trunnion-pins of the valve-gear slide blocks. Rivet the two plates together temporarily, drill the holes, and saw and file to outline, as described for the "Bat."

The buffer and drag beams are the same as the "Bat's," except that the ends are square, and not scalloped out; so there is no need to elaborate upon how to make them all over again. The frames are erected exactly the same way, taking extra-special care to have them true and square. As there is no bogie, there is, of course, no bolster plate; but no cross-staying will be needed, as the



Top of beams.

all my  $2\frac{1}{2}$ " gauge "Live Steamers," with axleboxes to suit. The bogie of the "Bat" would not be centrally sprung, but made up to correct Southern practice, as shown on the drawing of the bogie for the S15 class of that railway, blueprints of which (from my original sketches) can be obtained from certain of our advertisers. Cylinders for the "Bat" would be  $13/16$ " bore, and for the "Owl"  $\frac{1}{4}$ " bore, the stroke in both cases being  $1\frac{1}{2}$ ". The wheels, twice the "0" gauge diameter, would have treads  $\frac{1}{4}$ " wide, and flanges  $1/16$ " thickness and  $3/32$ " depth. I think that clears up all points raised, and indicates pretty well how the change in size can be effected by anybody who wants to build a bigger engine.

cylinder block and the spectacle plate will provide all the staying necessary, so that the frame will be quite rigid when the "works" are all assembled.

### Running Gear

No separate drawings are needed for axleboxes, hornstays, wheels and straight axles, as these, except for wheel diameter, are exactly the same as recently illustrated for the "Bat"; so go right ahead, and make and fit them. Axleboxes are  $\frac{3}{8}$ " lengths of  $7/16$ " by  $3/16$ " bronze or hard brass rod, slotted to fit openings in frames as per "Bat" sketches, and furnished with  $1/16$ " spring pins running in angle-brass hornstays; but the

spring pins must not project more than  $\frac{1}{4}$ " below the hornstays, on account of the small driving wheels. Otherwise, they will foul all check rails, point rails and crossing frogs, when the engine is running.

The six driving wheels are turned to  $1\frac{1}{2}$ " diameter on tread, but a weeny shade above or below this will not matter; so long as the running position of the axleboxes is O.K., the working of the engine will not be affected in the slightest. Follow the "Bat" instructions, making the wheels  $\frac{1}{4}$ " width over tread and flange, the latter being  $3/32$ " deep and  $3/64$ " wide at root. The centre bosses project  $1/32$ " as before, and can be drilled without a special jig, same as the "Bat's"; but the distance from the centre of the axle hole to the centre of the crankpin hole is  $\frac{1}{4}$ " only. This follows big practice; Stroudley, Drummond and several other locomotive engineers gave their coupling-rods a less amount of throw than the cranks. It makes the engines run a lot sweeter at high speed, as the balance is not upset so much. You can twiddle the handle of your slide-rest at perhaps 300 r.p.m.—but try to turn the handle of the good lady's wringing machine at the same speed!

All six crankpins are made to the same dimensions as those in the "Bat's" trailing wheels, and are pressed in so that a bare  $\frac{1}{4}$ " of plain part projects beyond the wheel boss.

The leading and trailing axles are turned to the same dimensions as the "Bat's" trailing axle, and the leading and trailing wheels can then be "quartered" and pressed on, "Bat" instructions being once more followed; but the coupling-rods are different, being double length and jointed, so, if all is well, I will give a separate sketch of these in the next instalment of the "Owl serial," and also a drawing and instructions for making the crank "axlette." Good folk who have no

oxy-acetylene apparatus need shed no tears on this job, for the tiny component could be brazed with a mouth blowpipe!

### An Injector Tip

A follower of these notes made up a little injector, as described for "Miss Ten-to-Eight," fitted it to a  $3\frac{3}{4}$ " gauge L.N.E.R. "Pacific," and complains that it works perfectly up to about 60 lb. pressure, but above that "knocks off" and blows steam and boiling water through the overflow. On my asking *how* it was fitted, he replied, same as specified, except that he utilised a  $3/16$ " steam pipe and valve which was already fitted to the boiler. Therein lies the explanation of his trouble.

As explained in the "beginner's guide," the action of the injector depends on the perfect condensation of the steam jet in the water, and it is obvious that an excess of steam from the jet will not all condense, but will boil up the water instead and blow it out of the overflow. Now, to get the right amount of steam coming out of the cone at the right velocity, the steam valve, pipe and cone have a definite relationship. If a bigger valve and pipe is fitted, pressure at the cone will be higher, and more steam will pass through, with the result mentioned above. All our friend needs to do, is to fit a smaller steam cone, with the same taper, but drilled No. 61. This will pass the same amount of steam at the same speed as the specified cone and pipe of the original; and the little injector will then operate at the working pressure of the "Pacific" without knocking back the needle of the steam gauge when the engine is running. The tip may be useful to others in like trouble; the rule is, the larger the valve and steam pipe, the smaller the steam cone should be for a given working pressure, and vice versa.

## Model Engineers and National Service

(Continued from page 211)

In this case, however, it should only be the merest skim, as a heavy cut might throw up a burr into the thread, which would be worse still. A selection of ending tools of various types, intended for cross-slide mounting, are shown in Fig. 35.

The die-head for threading the bolt is brought into operation at the next stroke of the capstan, and must be set for diameter and length of thread. If a solid ring die is employed, little or no diameter adjustment may be provided, but the expanding type of die-head has a micrometer adjustment, which covers a fairly wide range of size. If the trip gear which disengages the die is operated by an internal stop pin, the latter must be adjusted to the required depth; but some types of die-heads

are designed to release when the capstan slide is stopped, and in this case the end-stop of the slide is set to produce the required length of thread.

Only two operations remain to be performed; the bevelling off of the bolt head, and parting off. These are carried out by tools mounted in the front and rear tool-posts of the cross-slide, respectively. When the finishing work is parted off, the work-stop is indexed into position and brought forward to the full extent; the chuck is then opened and the bar allowed to run out against the stop, after which the chuck is again closed and the sequence of operations repeated as many times as may be necessary.

(To be continued)

# Model Locomotive Performance

By W. B. Hart

IN the "M.E." for November 30th last, it is stated that the Romford Model Engineering Club are endeavouring to discover a basis of comparison of the performances of model locomotives. It is suggested that the only reliable factor on which comparisons can be made is drawbar pull. At the moment, the favourite method is to state the "load hauled." Whilst this is a simple and convenient way of comparing the performances of two locomotives made on the same track and, say, the same day—even this may not give a true comparison—it is quite useless for comparison with the performance made by a locomotive on a different track.

On the track at Streatham, careful records have been kept of the performances of the locomotives made at various times, and one is at once struck with the large variation in the "load hauled"—not merely as between one locomotive and another, but by the same locomotive on different occasions.

For some long time now it has been customary to note the drawbar pull in addition to other details, and it has been found that this not only gives a very good idea of the condition of the individual engine by comparing its drawbar pull with the pulls obtained on previous occasions, but can be fairly compared with the pull obtained from another engine on a different track at some other time.

## The Track and Gradients

Before giving some figures in support of this view, perhaps a short description of the track itself may not be out of place.

It is 5" gauge—with steel rails of  $\frac{1}{2}$ "  $\times$   $\frac{3}{4}$ " section on edge—with tube ferrules and through bolts approximately every 12". The track is laid on the ground, but is not fixed down in any way. The layout is continuous and about 220 yards long.

Commencing from the siding, there is about 100' straight at 1 in 200 up, followed by a half circle, left-handed, at 1 in 50 up; then 120' straight at 1 in 45 and 1 in 100 up, to the summit where there is 12' of level track, followed by 1 in 100 down. Then there is a quarter circle, left-handed—80' straight—another quarter circle left, and 100' straight—all at 1 in 66 down. Then comes a left and right S-bend, not quite a quarter circle each way; the lowest part of the track being in the middle of this, and we are back to our starting point. All curves are 30' radius.

The siding; which is alongside the straight at 1 in 200 up, is similarly inclined and has a facing connection from the main line into it at the lower

end, with a connection from the siding out to the main line at the upper end.

The usual procedure after a preliminary run round with driver only, is to add trucks loaded with bricks to the maximum that the engine can haul up the 1 in 50 bank from a standing start on the 1 in 200.

It is found that this maximum load will vary considerably. For instance, on July 1st, 1934, engine "A" could only take a load of 500 lb. at the commencement of a day's running—drawbar pull, 30 lb. Later, the same day, this engine was taking 921 lb. quite easily—drawbar pull still 30 lb.—the increased load being entirely due to the reduced track friction, as the initially rusty rails were becoming polished.

On May 20th, 1934, engine "B" could just manage 656 lb., yet on May 28th it could manage 751 lb., but on May 30th 635 lb. was all it could take round—the drawbar pull was taken on each occasion, and was 30 lb.

## Not a "Flash in the Pan"

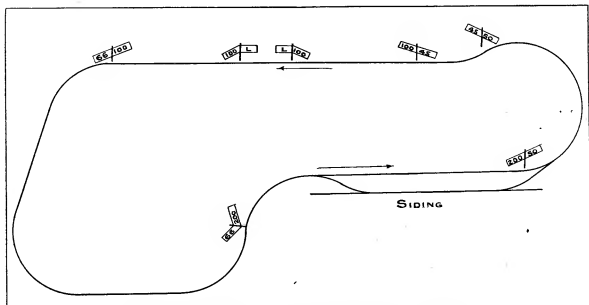
In all cases these loads were taken round the track many times, showing that the performance was not just a "flash in the pan."

Of course, a great deal depends on the driver. On many occasions an engine has been taking a load round apparently quite easily, but on making a change of drivers, the new man is quite unable to negotiate the bank.

Again, three of the trucks are fitted with ball-bearings, and two with plain bearings. The latter, when in good condition, absorb just twice the power required to move them that the ball-bearing trucks require, at all loadings from "empty" to 2 cwt. per truck. When not in good condition, there is no knowing what power they require! It has happened more than once when a plain-bearing truck has been included in the train that the load has been too much for the engine, but the judicious use of the oil-can has enabled the engine to overcome it.

It has also been found that an engine can haul the trucks only when they are in a certain order—re-marshal the train and the engine can no longer haul it! Of what use is it then to quote the "load hauled"?

The steel rails have now been down nearly 10 years in all weathers, and as a result of pitting and rusting, the trucks can be left unscotched in most places without movement. When first laid, it was impossible to leave a truck unattended



The layout and gradients of the model railway track at Streatham.

anywhere, except at the bottom dip; if left anywhere else it promptly gravitated to that spot.

As a result of this gradual increase in the track friction, the maximum loads hauled now are only about three-quarters of those hauled in the past; yet the drawbar pulls have shown a tendency to increase.

When taking a drawbar pull the driver must, of course, not be actually touching the engine when a reading is being taken. It is better, having got the train under way, for the driver to concentrate on the spring balance and to have someone walking ahead with a small bag of sand which can be dropped intact on the track to stop the engine should a breakaway occur—as this can very easily happen if the speed drops, when violent surging invariably takes place.

The peak readings of these surges are of no value; only the steady reading should be recorded.

On a level track it is probable that to get the maximum drawbar pull, sufficient resistance cannot readily be obtained by loading the train—a better way is by applying the brake.

If the track is elevated it is a good plan to have someone walking beside the engine who does the driving, the normal driver concentrating on the spring balance and the brake. Give the engine steam, get the train under way, and then check the acceleration by means of the brake *on the track*; so as to maintain the speed constant and as slow as is consistent with a steady reading on the spring balance.

#### An Ideal Arrangement

The ideal arrangement would be a dynamometer car, as designed and made by Mr. McCall, in which a clockwork-driven drum carries a paper

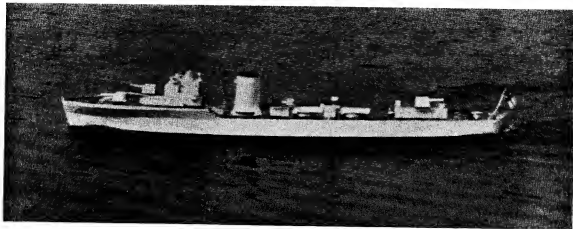
chart on which two pencils mark curves representing, one the speed and the other the drawbar pull. These pencils approach and recede from each other on either side of the longitudinal centre line of the chart, so that at any instant the drawbar pull and speed appear one above the other on the chart.

The length of the chart is sufficient to give more than one circuit of his track, the drawbar is fitted with a dashpot to damp out oscillations, and a hand device is operated at certain points of the track which makes a mark on the chart and thus enables one chart to be compared with another. This dynamometer car is in the rear portion of the driver's car and is looked after by an attendant travelling on a following car.

An arrangement of this sort enables the drawbar pull to be taken *and recorded* at various speeds, but, failing this, the taking of the pull always at an approximate speed of 3 miles per hour seems to give a fairly true indication of the respective powers of different engines.

Taking the drawbar pull at low speeds might seem to favour small-wheeled 6-coupled as compared with a large single-driver, because at high speeds the internal resistance of the small-wheeled engine might be expected to absorb most of the power, so leaving little available to haul the train; but in practice this does not seem to be so, as the 6-coupled engines seem to be capable of any speed with a load that the driver, and in these cases he is also always the owner, is mad enough to take the 30' curves.

Presumably, the speeds are not sufficiently high for the increase in internal resistance to have much, if any, effect.




## H.M.S. "Kingston"

A model built from simple materials

By R. F. Dolphin

THIS model of H.M.S. *Kingston* was built in my spare time at home, and took two months to complete after previously preparing the drawings. It is 4' 10" in length, beam 7", and a depth of 6" at the main deck. It represents the new class of destroyer that is now being introduced, and the first of its kind to appear with a single funnel in the British Navy. They are beautiful boats, both in appearance and performance, the only thing which seems strange is the absence of a main mast; however, the ensign staff serves the purpose, and the wireless aerials are slung from the fore topmast yard to a yard on the ensign staff. They displace approximately 1,700 tons. The main armament consists of ten 21" torpedo tubes in two sets of five, and six 4.7" guns in twin mountings, with other small A.A. guns.

The hull was built up from strips of sheet tin soldered together upon a wood framework. There are eleven section pieces of three-ply wood, and the stem and stern pieces, which are cut from wood to the actual shape of the bow and stern. They are then secured on the building batten 5" apart, making sure that the centre line of each section is in line with the centre line of the batten and plumb. The actual building of the hull was given in the issue of the "M.E." dated August 24th, 1939, in the article on *Ajax* by the same author. The procedure is exactly the same for this hull.

It is very important to wipe all soldered joints with a damp rag whilst still hot, for it cleans off any "baker's solution," thereby helping to prevent rust and prolonging the life of the model. After levelling off the deck edges, cut out some 2" strips of tin of convenient length. Bend them over thus:  The  $\frac{1}{4}$ " edge fits inside the hull and is soldered there, leaving the  $\frac{1}{4}$ " side level with the

deck edge of the hull plating. Check each strip before soldering into position permanently with its opposite number on the other side of the hull, and see that they are level with each other. The  $\frac{1}{4}$ " side now serves as a ledge for the remaining deck sections to rest on, bending the other edge over strengthens the strip and keeps it rigid.

### Decking

This is divided into five sections. The Fx. deck, 10" long, which is soldered on permanently. The bridge deck, 9" long, which is hinged on the starboard side to allow the blowlamp to be inserted and attended to. The main deck, 22" long, is removable, and rests on the  $\frac{1}{4}$ " deck ledge, and is held in position by bolts. The aft deck is 10" long and is also removable, and held by bolts. Lastly, the quarter deck,  $7\frac{1}{2}$ " long, is soldered on permanently. The deck edge is finished off by soldering a  $\frac{1}{8}$ " wire beading all the way round the model. It is advisable to give the hull a coat of composition anti-fouling or a similar kind of paint as soon as possible. This can be done after the following jobs are completed.

Propeller shaft and rudder tubing soldered in position, two hawse pipes in the bows to house the anchors, two rows of port-holes on the Fx. sides and one row aft, using brass boot eyelets for this. The jack staff soldered in on the bows, fair leads and bollards along the deck edge, and the depth charge cradle aft.

### Torpedo Tubes

These are made from brass tubing which was obtained from the handles of several old bicycle pumps. Ten tubes were required, each 4" x  $\frac{3}{8}$ ". Close one end up by soldering on a tin disc. The

opposite end is cut to shape the lip of the tube. Now cut out two tin straps,  $2\frac{1}{2}$ "  $\times$   $\frac{1}{2}$ ", and solder the tubes on to these, leaving a gap of  $\frac{1}{8}$ " between each tube. By soldering a 4 B.A.  $\times$   $\frac{1}{2}$ " bolt underneath in the centre, they can now be secured to the 2"  $\times$   $\frac{1}{4}$ " mounting and the deck, being able to revolve at will.

### Guns

A solid turret was first made from wood and then each turret was made up round this, the edges being finished off with a wire beading. The gun barrels are made from copper tubing. Solder the end of a length of  $1\frac{1}{2}$ "  $\times$   $3/16$ " copper tubing into  $1\frac{1}{2}$ " of  $\frac{1}{4}$ " tubing, then taper it down in the lathe. They are now soldered to a  $\frac{3}{8}$ " tin strap with  $\frac{1}{4}$ " apart at the breech end. The ends of the straps are now bent over about  $\frac{1}{8}$ " and soldered to the inside of the turret-shield, giving them an angle of 5°. The  $1\frac{1}{2}$ " mounting is now soldered on to the underneath of the barrels at the breech end with a small piece of tin bent at right-angles, the other side of the mounting is then soldered to the front end of the turret-shield. The whole is bolted to the deck.

The four-barrel pom-pom was made up with  $\frac{1}{8}$ " copper tube, sheet tin and copper wire. Four pieces of  $\frac{1}{8}$ " copper tube,  $\frac{3}{4}$ " long, serve as the barrels; these are soldered into a piece of tin,  $\frac{3}{8}$ "  $\times$   $\frac{3}{4}$ ", the bottom pair protruding  $\frac{1}{8}$ " more than the pair above them, this is then soldered into the mounting. A piece of copper wire is used as a hand-rail and is soldered  $\frac{1}{4}$ " above the platform and is the same shape. The mounting is now soldered to the baseplate,  $1\frac{1}{2}$ "  $\times$   $\frac{3}{4}$ ", and a  $1\frac{1}{4}$ " brass curtain ring. This is then bolted to the deck just as the other fittings are.

### Range-finder

This was made from a  $\frac{1}{2}$ " length of 6 B.A. screw rod with a nut screwed and soldered on each end.

The pedestal is a cheese-head 4 B.A. bolt screwed into a wireless terminal. This is then soldered to the  $\frac{1}{2}$ " piece of 6 B.A. rod, and finally the whole pedestal was soldered to the rangefinder platform.

### 0.5-in. A.A. Guns

The four barrels of  $1/32$ " brass wire are soldered into a small strip of tin, being  $1/16$ " apart, they are staggered so as the bottom one protrudes more than the one above it. The mounting is now soldered to a  $\frac{1}{2}$ " tin disc and curtain ring, and is finally bolted to the deck.

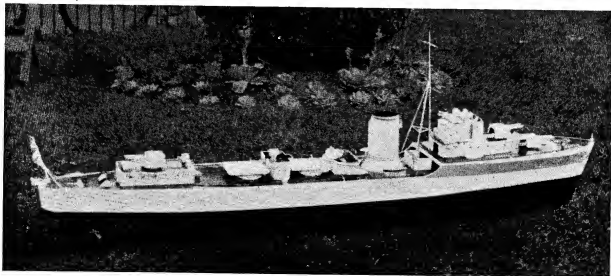
### Searchlight

This was made from a  $\frac{3}{4}$ " length of  $\frac{1}{2}$ " tin tube, one end being closed by soldering a tin disc to it. The smoke-box on top is a small piece of tin bent to this shape, similar to the motor-box which is underneath the barrel. The U-shaped mounting is cut and filed from a strip of  $1/32$ " brass plate, and is soldered at the pivots to the barrel. The bottom of the U-mounting is then soldered to the tin pedestal which is then bolted to the searchlight platform.

The bodies for the two paravanes were made from wood, being  $1\frac{1}{2}$ "  $\times$   $\frac{1}{4}$ ", one end rounded off and the other tapered. A piece of  $1/32$ " brass was cut, and used for the plane, soldering on each tip a length of  $\frac{1}{8}$ " copper tubing. A brass pin is now soldered to the centre of the plane, and by this means the plane is attached to the body. The horizontal and vertical planes are small pieces of tin forced into the tail.

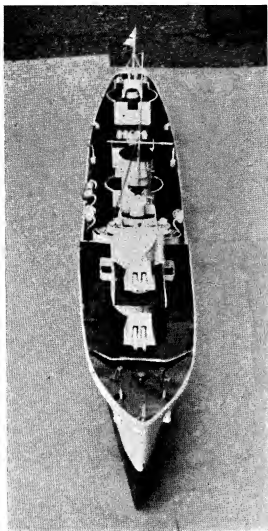
### Depth Charge Cradle

This was built up from strips of  $\frac{1}{8}$ " tin angle plate. The ensign staff runs through a hole in the top plate of the cradle, and the base is threaded which screws into a nut soldered on the deck. The two supporting stay-legs are of  $1/16$ " brass rod; they are soldered at the top to a brass ring,



Awaiting her turn.





The deck layout from forward.

which is just large enough to allow the staff to pass through. The bottom of the legs are soldered on deck.

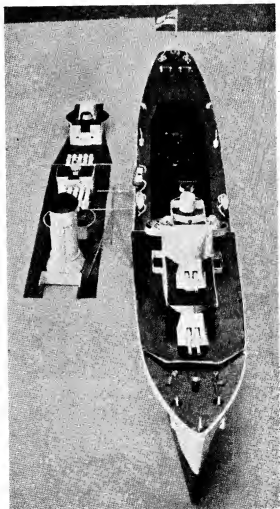
Lengths of  $\frac{1}{8}$ " and  $\frac{3}{32}$ " brass rod were cut to build up the tripod mast. A wooden jig was made by drilling the mast socket holes in a piece of wood. The foremast is then placed into the hole at the apex, and then the two stays into their respective holes. When they are true and equal distance, solder the stays to the mast at the point where all three meet. The foremast is  $\frac{1}{8}$ " rod, and the stays  $\frac{3}{32}$ " rod. The remaining yards and fore topmast are also  $\frac{3}{32}$ " brass rod. The mast is fitted to the deck in sockets, these are  $\frac{1}{2}$ " lengths of copper tube soldered to the deck, and the mast and stays fit tightly into the tube, and is removable.

All the four boats are carved from yellow pine, consisting of one power boat and two whalers, which are slung at the davits head, and the skiff,

which is stowed on deck in crutches just before the after superstructure. The davits are made from  $\frac{1}{8}$ " brass rod, being tapered at one end first and then bent to their required shape. A  $\frac{1}{32}$ " hole is drilled in the tapered end for use in securing the boats. This is done by passing a pin through the hole and forcing it into the boat. The pin can be soldered if required, this will help to keep the boats steady.

The boiler is a copper centre flue, silver-soldered at all joints. Its measurements are  $9" \times 4\frac{1}{2}"$  with a  $2"$  centre flue having ten  $\frac{3}{8}"$  cross tubes. It was tested to 180 lb. per sq. in. under steam, but the working pressure is about 50 lb. per sq. in. Fittings include a safety-valve, pressure gauge, and stop-cock. One filling of the boiler will last for 25 minutes, and a steady pressure is maintained by the blowlamp. The position of the funnel is too far forward to take the exhaust from the blowlamp. This was overcome by using the pom-pom gun deck, aft of the funnel.

(Continued on page 223)



A deck view, showing the two main deck sections removed.

# \*The History of "Tich Too"

An account, based upon records in the log book, of the development of a miniature flash-steam hydroplane

By H. J. Turpin

THE conclusions reached regarding the pump troubles were that the valve seatings—in aluminium alloy—became deteriorated in the space of a few hours as evidenced by (a) the few good runs that occurred when the pump had been reconditioned and no water passed through it until the actual run; (b) unsuccessful runs resulted always after the pump had been reconditioned and tried under water on the bench—usually on the Saturday preceding the trial—and then taken to the pond the following day; (c) my last and final conclusion is that an aluminium alloy is not suitable

for any functioning mechanism that is in intimate and continuous contact with water.

The oil pump which was made of similar material did not fail once throughout the season. It has been a case of fit and forget.

## Engine

The engine this time is a  $120^\circ$  vee twin. Some folk will say "Why not  $180^\circ$  twin?" The latter arrangement results in an engine that is very inaccessible, as it is impossible to get a screwdriver in position athwart the hull for dismantling. With the  $120^\circ$  arrangement I can get at the cylinder-heads and cylinders by a screwdriver just clearing

the upper edge of the hull. Also, the total height is well inside the height of the hull. Fig. 19 shows an assembly of the engine without the pumps. These are mounted on the respective platforms as indicated and are shown assembled in Fig. 17. The oil delivery shown as "to engine" actually projects forward to couple with the oil union shown in Fig. 19.

Cylinders are staggered, the right one being  $\frac{1}{4}$  in. in advance of the left because both connecting-rods are on the same overhung crankpin. Bore is  $\frac{3}{8}$  in. and stroke  $\frac{5}{8}$  in. Each cylinder has a bottom flange with a spigot registering in the inclined wall of the frame and is held with four 4 B.A. screws.

\*Continued from page 116, "M.E.," February 15, 1940.

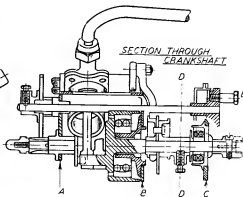
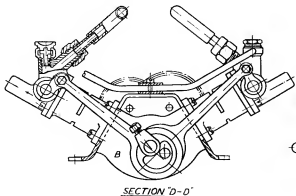
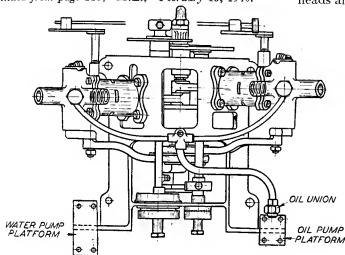


Fig. 19. General views of engine with pumps omitted.

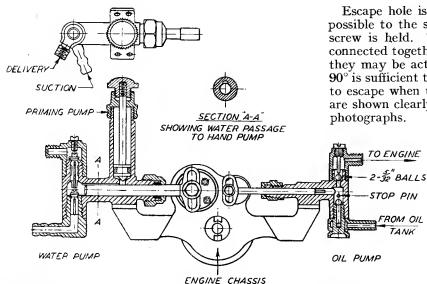


Fig. 17. Section through aluminium alloy pumps, and method of driving.

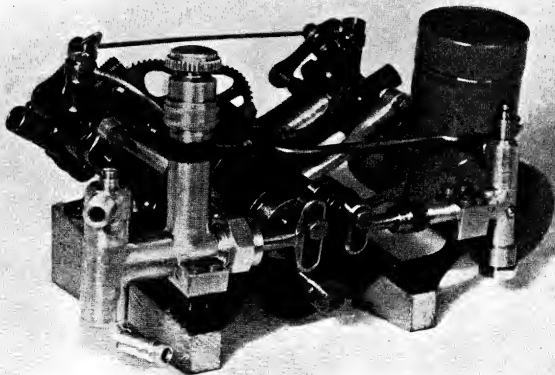
Built into the top flange is the drain cock, the body of which is made from  $\frac{1}{4}$  dia. mild steel brazed into the corner made by the cylinder wall and flange. It is then drilled and tapped 2 B.A., and a hole 0.10" dia. drilled straight through to cylinder bore. As the top of piston is within 0.03" of the top edge of flange it is necessary to add an inclined cut to the cylinder wall in order to connect escape hole to top of piston.

Escape hole is 0.10" dia. and drilled as close as possible to the seating against which the 2 B.A. screw is held. The screws in each cylinder are connected together by an 8 B.A. steel wire so that they may be actuated together. A turn through 90° is sufficient travel of the screws to allow water to escape when under pressure. The drain cocks are shown clearly at the top of Fig. 19 and in the photographs.

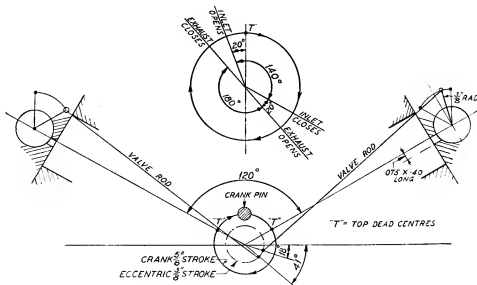
Steam release ports, four in number, for the bottom of the stroke are shown in Fig. 20, and are made with a cutter  $\frac{7}{16}$ " dia., 0.06" thick.

Cylinder-heads and valve-gear are a little unusual as applied to models. Some years ago I was apprenticed to a firm whose speciality was the Corliss winding engine with a cable drum about 18 ft. diameter. The cylinders were, say, 3 ft. diameter, steam being distributed by four Corliss valves per cylinder. These valves were probably 8 in. diameter and 3 ft. 6 in. long, placed across the cylinder, a steam valve at top and exhaust valve at bottom at each end.

A wrist plate on the side of the cylinder placed equidistant from the four valve centres reciprocated each valve by a link and trip motion. The



Three-quarter view of engine, left side, looking forward.



**Fig. 21.** Line diagram of link motion.

operation of this link motion has always fascinated me, and it was with such recollection in mind that induced me to produce the type of valve for *Tich Too*.

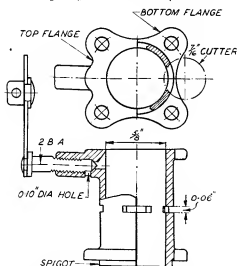
A disadvantage of the Corliss type valve is that the steam, when admitted on one side, presses it heavily to the other side of the valve with a tendency to wear. In *Tich Too's* valve I have taken the incoming steam through slots in the valve and so partly balanced the pressure.

will be noticed here that the cut-off is rather late. This was intentional, of course, but I think it resulted in undue waste of steam, and for *Tich* III steam has been made to cut off at 90° past T.D.C. instead of 120°, the exhaust opening remaining the same. The line diagram should be self-explanatory as all the relevant parts are marked.

(To be continued)

### H.M.S. "Kingston"

(Continued from page 220)



**Fig. 20.** Detail of cylinder with water release.

The advantages are: 1, relatively quick port opening and closing; 2, minimum length of steam passage from valve to piston top is minimum clearance volume. This passage is only 0.075" long; 3, low inertia of valve due to reciprocating rotational movement of only 60°

Fig. 21 shows the line diagram of link motion, and the timing diagram which it produces. It

## Blowlamp

This is a petrol lamp, with a 4"  $\times$  2½" silver-soldered copper container. The flame tube is 3½"  $\times$  1½" with two rows of air holes, one row consisting of eight ⅛" holes, and the other eight 3/16". Five turns of 3/16" copper tube round the flame tube vaporise the fuel, which is controlled by the stop-cock. Pressure is obtained by use of a bicycle pump, and the lamp when three-quarters full will last for 20 minutes. A gearbox is employed to turn the propellers in opposite directions, which is outwards. Four gear-wheels were obtained from the hubs of three-speed bicycles, and encased between two ¾" brass plates. Each shaft takes its drive from the outside wheel by means of dog-couplings.

The engine is a Stuart "Sun" and, although eight years old, has been used in many other models, and it is just as good as ever. The methods of superheating is the same as employed in the cruiser *Ajax*, by placing four turns of the steam pipe in the centre flue at the exhaust end.

After the hull has had two coats of anti-fouling, an under coat of white is then applied. The final coat is Mediterranean pigeon-grey enamel, with the water line of black. A coat of anti-fouling was also given the deck and then varnished over.

(To be continued)

## \* Model Aeronautics

A series of articles dealing with the theory and practice of model aeroplane building

By Lawrence H. Sparey

### Propellers (contd.)

HAVING covered the design, setting-out and carving of model airscrews, we will examine some suitable materials.

For model propellers, wood is undoubtedly the most suitable substance; although metal airscrews (of aluminium or its alloys) have sometimes appeared. Personal experience has convinced me that there is no advantage to be gained by their use, except, perhaps, for exhibition purposes—although a well finished and polished laminated wooden propeller wants some beating even in this respect.

Alloy airscrews are approximately three times as heavy as their wooden counterparts. They are, of course, stronger, yet even this virtue may prove a disaster, as a bad crack-up when flying may mean a bent engine crankshaft or broken crankcase instead of a smashed propeller blade. My choice is for the latter calamity.

In the other extreme, balsa wood propellers may be ruled out for use with petrol-engined model aeroplanes; and we are left with quite a selection of hardwoods which are suitable for our purpose. Beech, mahogany, oak, rosewood, spruce, beech and ash are all good. Perhaps the best of all is walnut, especially the kind known as "black walnut." In addition to being a very handsome

wood, it is strong, has a certain resiliency, and is not difficult to work.

### The Laminated Propeller

The soundest proposition of all is, without doubt, the laminated propeller. Quite a variety of combinations of wood may be used, or even laminations of the same wood—mahogany, for instance—in which case, the layers of wood will have the grains running in slightly different directions. However, if one is taking the trouble to make a laminated propeller blank, it is as well to choose some well-tried combination giving the maximum strength. Favourites are whitewood and mahogany, and spruce and black walnut.

All the required virtues are inherent in a combination of spruce and black walnut, correctly glued together, in alternate laminations. In addition, these woods are of different colours; the spruce being of a light yellow shade, while the black walnut is, as its name implies, almost black. This gives a very fine effect in the finished airscrew; as was demonstrated in the photographic illustration of such a propeller in our Fig. 97 in THE MODEL ENGINEER of January 11th last.

To be successful, these laminated propeller blanks require careful making, especially in the gluing process. Careless methods—known in the trade, I believe, as "cold glue and hot nails"—will be just as much waste of time and money.

\* Continued from page 162, "M.E.," February 15, 1940.



Fig. 128. Mr. E. Ross's "Southampton Star," a winner of a Bowden International Trophy Contest. In our picture can be seen Father Amiand, a French priest, who was a frequent visitor to English model plane meetings before the war. Father Amiand conducts a school at Fleurs, where one of his "subjects" is aero-modelling.

The following is a description of the correct system.

So much depends upon the glue that a few words may be useful in this connection. In the first place, a proper gluepot should be used. A small one is quite cheap to buy and will last for ever. The best Scotch glue should be bought, either ground to a powder or in the slab. In the latter case, it should be broken into small pieces and soaked in cold water for at least twelve hours. Powdered glue will need no soaking.

The glue should now be boiled, adding water as this evaporates, so that the consistency becomes that of very thin treacle. It should run off the brush quite easily; in fact, almost like water. It must be used when *absolutely hot*. The hotter the glue, the stronger will be the resultant joint. Glue loses much of its strength when often melted; so we will, in this instance, be sure that the glue is freshly made for the job.

### Preparing the Wood

Now for the preparation of the wood. Each lamination may be about  $\frac{1}{8}$ " in thickness; so, the required number having been determined, the slips of spruce and black walnut will be planed-up to an even thickness, with all faces square. This is not quite so simple as it sounds, except to experienced woodworkers, but may be successfully done by the careful amateur. It is an advantage to make the surface very slightly concave, as is shown in an exaggerated manner in Fig. 129.

When all the slips have been prepared, the gluing surfaces should be slightly scarified with the edge of a file, or a fine hacksaw blade. This provides a key for the glue.

The glue, being by now *hot* and *thin*, is ready for service; so the slips of spruce and walnut are thoroughly warmed before a fire. The glue is now quickly applied with a brush to the surfaces of two of the slips (each, of course, of a different wood) and these are swiftly placed together, and all the surplus glue pressed out. Then, as quickly as possible, apply the remaining laminations.

The glued block should now be placed in the jaws of a vise, between two stout pieces of deal or other soft wood, with some slips of newspaper between these and the actual blank, to prevent them sticking to it; and the whole clamped tightly.

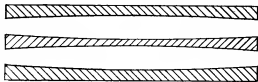


Fig. 129.

Leave in this condition for 24 hours, and you will have a laminated propeller blank that will never come apart or burst in use.

The whole aim is to lose as little heat as possible

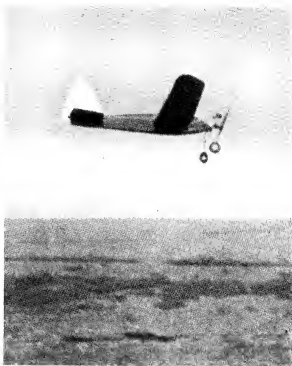


Fig. 130. In the air: A streamlined 5 ft. 6 in. midwing, with a "Brown" engine by Mr. F. Foster. Note the downthrust on the propeller.

during the time between the application of the glue and the clamping up. This is the secret of successful gluing—hot, fresh, thin glue; and those readers that take the trouble to do the job correctly will find they have acquired a most useful art.

### Glues

Apart from Scotch glue there are some reliable brands of proprietary glues on the market. "Croid" is extremely good, while casein glues are now extensively used in aircraft work. Features of casein glue are that it is impervious to the effects of moisture, and that it has great strength. It does not, however, seem to be readily obtainable through ordinary retail shops, but may be had from Messrs. Hardan & Co., Brook Works, Cambridge Gardens, North Circular Road, London, N.13. (No connection, I assure you!) Most of these proprietary glues have their own instructions for use.

Some full-sized propellers are made from a great number of laminations of thin veneer. These airscrews are hollow, and are shaped, I believe, by some pressing method. Although such a system is beyond our scope, the use of many laminations of thin veneer presents some possibilities for strong and novel airscrews, made by the usual method. I shall be glad to hear from any readers who may try this system out.

Model propellers may be finished in a variety of ways. The simplest is to rub them with linseed oil; the best is to french polish them. Between

these two extremes there are some other good systems. Varnishing with "white hard" or "brown hard" varnish is as good as any, especially if three or four thin coats are applied, and each coat, except the last, is well rubbed down with fine glasspaper. This, in fact, is the secret of good varnishing, polishing or enamelling. In the good old days of coach painting—which era saw, probably, some of the finest paint and varnish work ever produced—it was said that the secret of a good finish was to put on twenty coats of paint and rub nineteen of them off. The principle is just as true to-day, although modern production methods hardly leave time to put two coats on and leave them there. Model engineers, however, are of that privileged class to which the perpetuation of the old craftsmanship has been left, and their paint and varnish work, whether on a model propeller, boat or locomotive, must be, like Caesar's wife, above suspicion.

### Staining

If you decide to stain your airscrew before polishing or varnishing it, do not use water stain, as this will bring up the grain, making a great deal of sanding necessary, with a probable rebalancing of the propeller. Spirit stain is much kinder to the surface, although even that is liable to need a good deal of rubbing down. Personally, I rarely stain a propeller, for I have never yet been able thus to improve upon the appearance of a finely marked piece of mahogany or walnut.

Some builders "improve" their airscrews with cellulose lacquer. This is useful to protect the propeller from damp, but the appearance is usually destroyed. Black cellulose is too heavy looking, while white or coloured propellers never look "right" somehow. It is easier to french polish your airscrew than to cellulose it correctly. In the first place, wood will soak up a surprising amount of paint before a finish begins to appear. This means that some sort of filler must be used to fill up the grain. My advice is to french polish your airscrew; it is quite easy, and I shall be pleased to give a few hints if readers so desire.

See where our amazing model aircraft have led us! From metal turning to gluing; from the making of small, woodworking planes to the theory of aerodynamics; from petrol engines to french polish. Truly, model aeronautics is the all-embracing art!

### Petrol

Apologies of my recent remarks on the running of small engines on "pool" petrol, I have had a lengthy correspondence with a reader of these pages. His first letter contained an appeal for advice on starting a 1 c.c. engine which he has recently finished. Beyond a few "pops" he had been unable to get it to run on any sort of petrol. Now, it is always safe to tell someone else why his engine should run, because, in the first place,

one can only pre-suppose that the design and workmanship is beyond reproach. So, all the usual hints and tips, and some unusual ones of my own, were duly forwarded to our colleague; yet results were still nil. Finally, the engine in question was sent to me for testing.

### Piston Fit

I am sure my correspondent will forgive me for saying that I spotted the trouble at first glance. The fit of the piston was anything but perfect, and even the small piston ring (very nicely made, by the way) failed to prevent a considerable blow-past, with consequent poor compression.

For the rest, there seemed nothing else radically wrong, and my advice was to discard the present piston and ring, and to fit a ringless, steel piston to a lap fit within the cylinder bore. That is to say, the bore to be lapped first, and the piston separately lapped to the closest limits possible.

This raises a point which, to my mind, has never been sufficiently emphasised. The making of these small engines of 1 or 2 c.c. capacity is really a watchmaker's job. Especially is this so in the matter of piston fit, which means, for one thing, that the bore must be dead parallel for its whole length—no simple job on the ordinary amateur's lathe. On larger sizes, of 10 c.c. or so, some small latitude will not prevent the engine from working, but such fits are definitely out of court on the real miniature.

Regarding rings on these smaller engines; I long ago discarded them on any unit with a bore of  $\frac{1}{8}$ " or less. A lapped steel or C.I. piston is a better proposition, as no allowance can be made on these jobs for the expansion of an aluminium piston, because there is then leakage when the engine is cold, and it will fail to start for this reason. Very few model engineers are capable of making and fitting a piston ring of this size with the accuracy required to prevent this initial trouble.

(To be continued)

## For the Bookshelf

**The British Journal Photographic Almanac, 1940**  
(London: Henry Greenwood & Co., Ltd.)  
Price 2s. 6d. net.

War-time conditions have resulted in a considerable reduction in the number of pages contained in this well-known and highly priced annual; but the excellent standard of production that has, in recent years, become its principal feature is fully maintained. Every page, from cover to cover, contains something of use and interest to all photographers, professional and amateur, and the 34-page gravure supplement is, in itself, an object-lesson in camera-craft.

# Queries and Replies

Enquiries from readers, either on technical matters directly connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by a coupon from the current issue, with a stamped addressed envelope, and addressed: "Queries and Service," THE MODEL ENGINEER, 60 Kingsway, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge. More involved technical queries, requiring special investigation or research, will be dealt with according to their merits, in respect of their general interest to readers, such as by a short explanatory article in an early issue. In some cases, the letters may be published, inviting the assistance of other readers.

In cases where the technical information required involves the services of a specialist, or outside consultant, a fee will be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the enquiry.

Only one general subject can be dealt with in a single query: but subdivision of its details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered as within the scope of this service.

## 7,716.—Winding a Static Transformer—H.S. (Acerington)

Q.—Can you please tell me how many turns and what gauge of wire to use on a transformer—the stampings are  $3\frac{1}{2}$ " by  $2\frac{1}{2}$ " by  $1\frac{1}{2}$ "—when assembled with a core measuring  $2\frac{1}{2}$ " by  $1\frac{1}{2}$ " by  $1\frac{1}{2}$ "? The transformer is to be used on a 230 volt circuit, and I want the secondary to deliver approximately 22 volts at 1 amp.

A.—An iron core having a sectional area of one square inch will, on a 50-cycle circuit, represent a reactance voltage of one volt for every eight complete turns of the winding, whether primary or secondary. For the 22 volt 1 ampere secondary, therefore, 176 turns of No. 22 will be correct, and for the primary 1,840 turns of No. 34 s.w.g., both double cotton covered copper. Wind on the secondary coil first, and then the primary over it, both being assembled on the same limb of the transformer, with at least 15 mils. of presspahn between.

## 7,737.—A Screwcutting Difficulty—E.D.S. (Usk)

Q.—A thread was cut on a  $\frac{3}{4}$ " diam. 10 t.p.i. square thread and of hard steel, and a phosphor-bronze nut 2" long was cut to match. The nut was fitted to a handwheel which gave  $3\frac{1}{2}$ " leverage, and this should be borne in mind when regarding "fit."

On fitting together, the nut screwed on with increasing difficulty, and, finally, with a spanner when the last three threads on the steel screw were sheared. This happened repeatedly, and finally pitch error was suspected. The pitch was eased on the thread until the nut passed comfortably along by hand. It was then found to have one-third turn backlash, notwithstanding that the thread had been eased by a few thou. only each trial.

It has also been noticed when cutting large diam. male threads that the thread cut seemed wavy, but this has been attributed to bad lighting and an optical illusion.

The lathe is a  $3\frac{1}{2}$ " Firth with a new leadscrew.

Would you state the above to be an error of pitch, and if so where should the trouble be looked for in view of the condition of the leadscrew? Do errors arise due to bad transmission through the leadscrew change-gears, or possible defects in the leadscrew end location? The leadscrew is 10 t.p.i., so that no difficulty is occasioned in meshing of the split-nut, and care was taken to arrange for all backlash to be taken up before the tool was advanced for cut.

A.—This trouble, more often than not, arises from a final thick thread in the nut. During the period of cutting the main body of a thread in the nut, the backlash in the combination: leadscrew plus longitudinal top-slide plus any other play (say a little in the mandrel), is kept all in one direction, and that is backward. This backward push is taken by the tool when it begins to cut on the front only, and is

maintained in *status quo* relatively to the work while cutting on both sides of the tool. On emerging from the back end of the nut, somewhere about the last half turn, the pressure is taken off the front of the tool and the resistance to cut still maintained on the back, which causes the last thread, so far cut, to push the play in the carriage forward, and also draw any play in the spindle backwards. Also, if there is any spring in a slender internal S.C. tool, this is released and adds to the trouble. Through this, one has seen (where a good deal of play due to wear is apparent) the last half thread get gradually visibly thicker, which causes it to wedge tightly in the screw and have the effect of stripping it by shearing at the bottom. The combination of varying "lash" in different parts of the carriage run of the lathe can account in this manner for a wavy effect (i.e., a so-called "drunken" thread effect), which will cause uneven pitching and uneven thickness of thread in the screw.

All these matters may arise from error in leadscrew mounting, and in lack of exact truth of screw running. For instance, in some lathes, with the screw used for traversing, the final finished turned work shows a series of rings, equally spaced and of equal width, that may show two or three ten-thousandths variation of diameter. This is sometimes caused by the carriage rocking on a warped leadscrew, and would have distinct pitch error effect in fine screwcutting. In respect of these errors, look to the presence of any end play in the leadscrew and take it out. It adds to the thick thread mentioned.

## 7,743.—Old Pewter—C.P.L. (Peaslake)

Q.—Will you kindly tell me how I can clean and polish old pewter plates, mugs, etc.? I have a power lathe with separate spindle for polishing.

A.—It would be a mistake to finish old pewter in any way to resemble modern pewter goods, just as it is a mistake to clean entirely and repolish old furniture or clocks, or indeed renew surfaces of old models and the like. As a matter of fact the whole business of the antique "faker" is to take new goods and make them look old, which does not succeed in misleading the expert. It is a worse vandalism to take really antique things and make them look new, which would offend the expert still more.

Such old pewter as we have interested ourselves in we have beaten to shape on hardwood turned formers and finished to smooth shape by hardwood smoothing burnishers, working on the formers. The surfaces have then been rough polished with material such as powdered bath brick with water rubbed on with a wet cloth. Carborundum powder will do, but none of these must be driven into the pewter. When evenly rough polished, the surface can be preserved by colourless lacquer put on cold.



# Practical Letters

## Stephenson Link-Motion

DEAR SIR,—It is common knowledge on the G.W.R. that Mr. Churchward always expressed and unchanging preference for Stephenson gear, and declared that, with long-travel valves, it gave the finest valve events obtainable; and it was freely said that he only adopted Walschaerts gear for his four-cylindred engines owing to the difficulty of getting in a sufficiently robust Stephenson gear combined with the necessary rockers, etc., for driving two valves off each set of motion, and at the same time designing an engine which could be got at by the driver for oiling and examination without too much difficulty.

I would not swear to it, as the drivers and firemen of the G.W.R. are not told the valve settings, nor is it their custom to pry into what does not appertain to the efficient performance of their duties, but I do not think that any of Mr. Churchward's outside-cylindred engines had lead in full gear except those fitted with Walschaerts gear, and it is definitely known that the 29's had negative lead.

I have myself seen drivers test the valves of a "45," "44," "31," "43," and "28" with the crank on dead centre, and unless the steam-rings were worn, no steam issued from the cylinder cock the same end as the piston, in any position of the lever. This proves, at least, that they had no lead as they were designed.

Every engineman's examination guide I ever saw says "Lead is given to provide a cushion for the piston at speed, and to help it on its return stroke."

The whole point which is driven into the men at improvement class is that it is the speed of the pistons and cranks when running fast, combined with their great weight and that of the connecting-rods, which make lead necessary if the engine is not to knock herself to pieces. At low speeds, as when starting, the need does not occur.

Any driver will tell you that engines with a big lead are always more liable to "centre" when starting, and having refused to start will not do so, even if reversed, unless the cocks are opened to relieve the lead on the centred piston, proving conclusively that the big lead actually acts against the other piston if the engine stops with one piston just short of the end of its stroke.

I have seen this often on the old L.S.W.R. 0-6-0 Neilson goods engines and on Adams's small 0-4-4 tanks, to say nothing of Drummond's engines, which I believe were some of the worst starters ever built and very poor, also, on a bank. If lead makes for quick starting, perhaps someone can tell us why they were so sluggish, for verily and indeed they had lead enough.

If the ports are big, and the valve moves quickly, I see no chance of the cylinder being starved in an engine with negative lead. At starting, the lead is no help, as the crank and piston are in line and the piston has no power. When running at speed, the lever is notched up and the lead is there to do its job.

The improvement class is the place de luxe, where technical details are discussed and knotty problems solved.

I have heard drivers and firemen grouse together over poor coal, dirty fires, the rough condition of

the engines, and the shortcomings of the Traffic Department, to say nothing of the iniquities of the "gaffer" and fitters, and I have heard many discussions regarding turns of duty, wages, promotion, etc., but I never heard any G.W.R. drivers criticise the C.M.E.'s designs and debate them. If an engine or class of engine is at fault, it is duly reported in the "Bible" provided for that purpose, and the riding inspector and others from C.M.E.'s department investigate the matter and apply the remedy.

Yours faithfully,

Plymouth.

ARTHUR J. MAXWELL.

## Lap and Lead

DEAR SIR,—There is one aspect of this matter of negative lead, or "valve lag," which does not seem to have been touched upon so far, and that is its effect on the full-gear cut-off. Before going into this, however, I would like to comment on the term "negative lead"; certainly, it is a contradiction of terms, but all the same it expresses the desired meaning exactly and without ambiguity, and there is ample justification for its use, as it is the normal practice in mathematics to deal with negative quantities in this way.

I do not profess to know what was in Mr. Churchward's mind when he evolved his standard link motion, but it is quite easy to trace the course of cause and effect. It is quite evident that he was convinced of the value of a much larger steam lap than was the usual practice and he settled on  $1\frac{1}{2}"$ , and having done this there immediately arose the problem of obtaining sufficient valve travel to give a reasonably late full-gear cut-off. Of course, the eccentrics could have been made large enough to give any travel required; but there are obvious objections to this, and evidently it was not thought advisable to use a greater eccentric stroke than was in common use. The value used was  $6\frac{1}{4}"$ , which was certainly greater than standard British practice, but it was usual enough in the U.S.A., and by using the so-called "launch-type" link the full-gear travel was equal to the eccentric stroke; but this was not enough to give a sufficiently late full-gear cut-off if there was any lead; actually, the cut-off would be 70% with  $\frac{1}{8}"$  lead. So it would seem that the gear was deliberately designed with very short rods so that the increase of lead from full to mid-gear would be very great, actually the lead was  $\frac{1}{8}"$  at 25% cut-off and  $-3/16"$  in full-gear; and this, in conjunction with  $6\frac{1}{4}"$  travel and  $1\frac{1}{2}"$  lap gave a cut-off of 77%. Now, the point is that there was no apparent need to have such short rods, at least on the 4-6-0's, and it would seem that the negative lead was actually arranged for, not for its own sake, but for this secondary effect.

When it came to designing the first four-cylinder loco., *North Star*, the  $1\frac{1}{2}"$  lap was again used, and as this machine had a Walschaerts type gear with the main travel obtained from the opposite crosshead, there was no reasonable limit to the travel and this was fixed at  $7"$  full, which also gave 77% cut-off with  $\frac{1}{8}"$  constant lead. Subsequent four-cylinder locos.

had the normal Walschaerts gear with eccentric main drive, and *North Star* herself was so converted after many years. Whatever may be the theoretical drawbacks of negative lead, there is no question that the Churchward two-cylinder locos. never showed any lack of liveliness under any conditions.

### Misleading Figures?

"L.B.S.C." suggests that large leads are used on various crack British and Continental locos., and that the published figures are misleading; that may be so, anyway the L.M.S. published figures give the largest lead of British machines,  $\frac{1}{4}$ ", the L.N.E. give  $\frac{1}{4}$ " and I understand the "A4's" actually have less; as regards the S.R., I know, on very reliable authority, that all the "Schools" and some of the "Nelsons" were at one time altered from  $\frac{1}{4}$ " to  $\frac{1}{16}$ ", they may have been altered again. But as regards the G.W.R., I do know by my own measurements that in Mr. Churchward's day, about 1910, the two-cylinder 30" stroke locos. had  $\frac{1}{4}$ " lead at 25% cut-off, and the four-cylinders  $\frac{1}{4}$ " constant lead, both in conjunction with  $\frac{1}{8}$ " steam lap and nil exhaust lap. Also, about 18 months ago, I had an opportunity of again checking things up; I found that there were still many of the two-cylinder machines with the  $\frac{1}{8}$ " and nil laps, but the "Manors," and the later "Halls," had the steam lap increased to  $1\frac{1}{16}$ ", the exhaust lap still being nil; these later cylinders had only 9" valves in place of the older 10", but the port width was increased to  $2\frac{1}{16}$ " instead of  $1\frac{1}{8}$ ". I do not know what the leads are, as this cannot be simply measured up with link motion. As regards the four-cylinder machines, I found that the "Stars" now have  $1\frac{1}{16}$ " steam lap and  $-1/16$ " exhaust lap and  $1/16$ " lead. With Walschaerts gear, it is an easy matter definitely to arrive at the mean leads; obviously, what happened here was that the valve pistons had been set  $\frac{1}{4}$ " farther apart, everything else being left unaltered. The "Castles" had the same laps as the "Stars," but the lead was  $\frac{1}{4}$ ". I think there is little doubt that the alteration to the "Stars" took place subsequent to 1925, and that the earlier "Castles" were turned out with the same setting as the "Stars." The "Kings" had exactly the same laps and lead as the "Castles," the only difference being that they have 9" valves with  $\frac{1}{4}$ " ports, whereas the other two classes have 8" valves with  $\frac{1}{4}$ " ports.

### A "Small Lead" Feature

The G.W.R. locos. may not be now quite the best in the country, but they are still pretty good; and they were certainly the pioneers of modern valve setting by a matter of twenty years at least, and with them the small lead has always been a feature. It should not be forgotten that lead cannot be treated as in "splendid isolation," the ratio between the lead and the steam lap has a very considerable influence on the timing of the release and compression, the smaller the ratio the earlier both these events occur. I quite agree that Continental locos. such as the "Chapelon" rebuilds have large leads; but these are compounds in which the conditions are quite different.

I have not the slightest desire to cause offence to our valued contributor "L.B.S.C.," but I would suggest, in all humility, that it serves little useful

purpose to discuss the more involved questions of valve setting while studiously avoiding all references to actual ratios and measurements when the whole problem revolves round such data. The article on lap and lead was most excellent and to the point, excepting where reference is made to large leads without the least indication as to what are considered large leads. To go to the extreme, we do not know that what "L.B.S.C." considers a large lead is what I, for instance, should consider large; he does state that the  $2\frac{1}{4}$ " gauge loco., which is said to have so much lead, has a cut-off of 18% in mid-gear; well, this to my mind does not suggest anything very extreme, I have made a practice of checking up and keeping copies of the valve settings of all my engines, and I know something of the limitations of Stephenson's gear in the  $2\frac{1}{4}$ " gauge sizes.

Yours faithfully,

Bexhill-on-Sea.

C. M. KEILLER.

### Those "Fresh Ideas"

DEAR SIR,—I have been a reader of THE MODEL ENGINEER for many years, and have seen the title on the cover change a few times, until it now seems to have crystallised into the ideal—simply as THE MODEL ENGINEER. Over this period, I have seen the Editor's endeavours to "feel the pulse" of the readers regarding their choice of articles. It has been good to see the change from subjects truly diverse from model engineering to mental fare which the ordinary reader looks forward to every week. We are now regaled with very interesting articles dealing with small engines, and descriptions of the processes necessary to enable the reader to follow in actual practice. The beginner and the veteran are both catered for. Now "Adage" bursts on the scene and puts forward a plea for new ideas. Does he not realise that uncommon engineering subjects would only appeal to a minority? His formidable list of suggested items, which appears to have been culled from the advertisement pages of the technical press, are, in the main, beyond the scope of the average reader. The detail necessary to be known could only be obtained from working drawings or descriptive articles in the relevant trade articles. Assuming such a model be made, its description would only bore the majority of readers who may not be engineers by profession or trade. It must be realised that this majority must be catered for, and the mental food on which they thrive must not be adulterated with the specialised diet of the food faddist. To each of them, according to his fancy, a small loco., or speed boat, or petrol plane, is the chief concern, and the fact that many are engaged in similar pursuits gives zest to the maker of such a model. More power to the elbow of "L.B.S.C.," "Spectator," "Artificer," E. Westbury, etc., who are now giving us what we want. Should any innocent modeller be beguiled by "Adage's" plea to make a model of, say, a greathed tunnelling shield, I trust that the Editor will not irritate me by publishing a description of such a museum piece. It is only my reluctance to encroach upon your valuable space which prevents me giving "Adage" some equally weird alternative suggestions.

Yours truly,

Malta.

"CLACK-VALVE."